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YANG Data Model for SR and SR TE Topologies
draft-ietf-teas-yang-sr-te-topo-02

Abstract

This document defines a YANG data model for Segment Routing (SR) topology and Segment Routing (SR) traffic engineering (TE) topology.

Status of This Memo

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This Internet-Draft will expire on January 2, 2019.

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1. Introduction

This document defines a YANG [RFC7950] data model for describing the presentations of Segment Routing (SR) topology and Segment Routing (SR) traffic engineering (TE) topology. The version of the model limits the transport type to an MPLS dataplane.

1.1. Terminology

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14, [RFC2119].

The following terms are defined in [RFC7950] and are not redefined here:

- augment
- data model
- data node

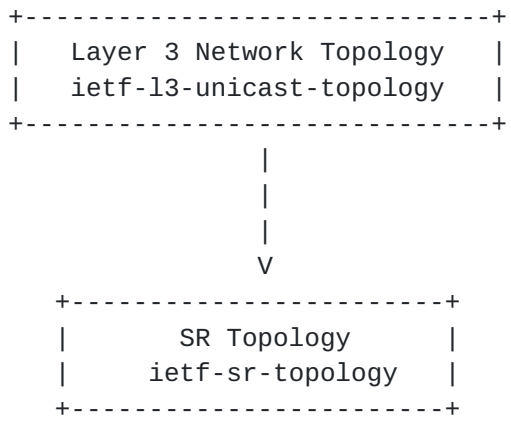
1.2. Tree Diagrams

Tree diagrams used in this document follow the notation defined in [RFC8340].

2. Modeling Considerations

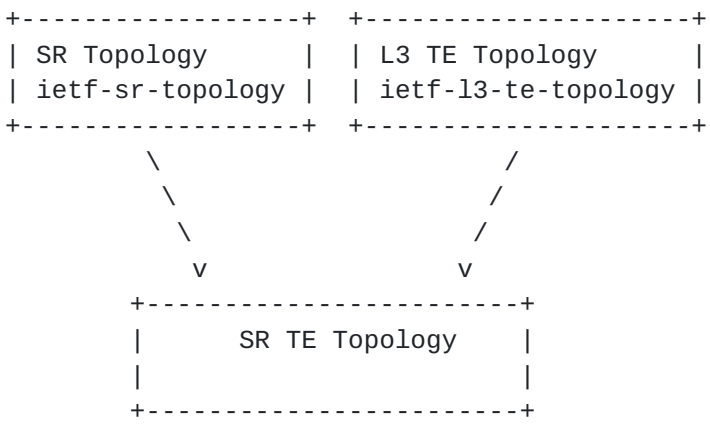
2.1. Segment Routing (SR) Topology

The Layer 3 network topology model is discussed in [RFC8346]. The Segment Routing (SR) topology model proposed in this document augments and uses the ietf-l3-unicast-igp-topology module defined in [RFC8346]. SR related attributes are covered in the ietf-sr-topology model.



2.2. Segment Routing (SR) TE Topology

When traffic engineering is enabled on an SR topology, there will be associations between objects in SR topologies and objects in TE topologies. An SR TE topology is both an SR topology and a layer 3 TE topology. Multiple inheritance is used to achieve such relations.



Each type of topologies is indicated by "network-types" defined in [RFC8345]. For the three types of topologies above, the data representations are:

L3 Topology:

/nd:networks/nd:network/nd:network-types/l3-unicast-topology

L3 TE Topology:

/nd:networks/nd:network/nd:network-types/l3-unicast-topology/l3-te

SR Topology:

/nd:networks/nd:network/nd:network-types/l3-unicast-topology/sr

SR TE Topology: (multiple inheritance)

/nd:networks/nd:network/nd:network-types/l3-unicast-topology/l3-te
/nd:networks/nd:network/nd:network-types/l3-unicast-topology/sr

2.3. Relations to ietf-segment-routing

[I-D.ietf-spring-sr-yang] defines ietf-segment-routing that is a model intended to be used on network elements to configure or operate segment routing; ietf-sr-topology defined in this document is intended to be used on a controller for the network-wide operations such as path computation.

SR topology model shares many modeling constructs defined in ietf-segment-routing. The module ietf-sr-topology uses the types and groupings defined in ietf-segment-routing.

2.4. Topology Type Modeling

A new topology type is defined in this document, to indicate a topology that is a Segment Routing (SR) topology.

```
augment /nw:networks/nw:network/nw:network-types
          /l3t:l3-unicast-topology:
  +--rw sr!
```

2.5. Topology Attributes

The Segment Routing attributes with topology-wide impacts are modeled by augmenting the container "l3-topology-attributes" in the L3 topology model. SRGB (Segment Routing Global Block) is covered in this augmentation. A SR domain is mapped to a topology in this model.

```
augment /nw:networks/nw:network/l3t:l3-topology-attributes:
  +--rw sr
     +--rw srgb* [lower-bound upper-bound]
        +--rw lower-bound    uint32
        +--rw upper-bound    uint32
```

2.6. Node Attributes

The Segment Routing attributes within the node scope are modeled by augmenting the sub tree /nw:networks/nw:network/nw:node/ in the L3 topology model.

The SR attributes that have node-scope impact are modeled by augmenting the container "l3-node-attributes" in the L3 topology model, including the SR capabilities, SRGB (Segment Routing Global Block), and SRLB (Segment Routing Local Block) specified on this mode. This model also provides the information about how these SR attributes are learned:

```
augment /nw:networks/nw:network/nw:node/l3t:l3-node-attributes:
  +--rw sr
     +--rw srgb* [lower-bound upper-bound]
     |  +--rw lower-bound    uint32
     |  +--rw upper-bound    uint32
     +--rw srlb* [lower-bound upper-bound]
     |  +--rw lower-bound    uint32
     |  +--rw upper-bound    uint32
     +--rw node-capabilities
     |  +--rw transport-planes* [transport-plane]
     |  |  +--rw transport-plane    identityref
     |  +--rw readable-label-stack-depth?   uint8
     +--ro information-source?         enumeration
     +--ro information-source-state
        +--ro credibility-preference?   uint16
```

The SR attributes that are related to a IGP-Prefix segment are modeled by augmenting the list entry "prefix" in the L3 topology model:

```
augment /nw:networks/nw:network/nw:node/l3t:l3-node-attributes
          /l3t:prefix:
  +--rw sr!
     +--rw value-type?          enumeration
     +--rw start-sid            uint32
     +--rw range?               uint32
     +--rw algorithm?           identityref
     +--rw last-hop-behavior?   enumeration
     |       {sid-last-hop-behavior}?
     +--rw is-local?            boolean
```

2.7. Link Termination Point Attributes

A link termination point in the topology model is mapped to an interface from the Segment Routing perspective. The Adjacency Segment attributes on an interface are modeled within a link termination point. The modeling structure is as follows:

```
augment /nw:networks/nw:network/nw:node/nt:termination-point
          /l3t:l3-termination-point-attributes:
  +--rw sr!
     +--rw value-type?                enumeration
     +--rw sid                        uint32
     +--rw advertise-protection?      enumeration
     +--rw is-local?                  boolean
     +--ro is-backup?                 boolean
     +--ro is-part-of-set?            boolean
     +--ro is-on-lan?                 boolean
     +--ro information-source?        enumeration
     +--ro information-source-state
        +--ro credibility-preference?   uint16
```

The usage of the leaf "advertise-protection" is described in [I-D.ietf-spring-sr-yang].

Since YANG models are usually implemented with persistent configuration datastores, this model supports only persistent Adjacency Segments.

Both IGP and BGP can be supported by the model, the leaf "information-source" is used to indicate where the information is from.

The bundling capability of the Adjacency Segemnt is achieved by re-using the existing modeling construct (i.e. "bundle-stack-level") under /nw:networks/nw:network/nt:link/tet:te [I-D.ietf-teas-yang-te-topo]

2.8. Link in the Topology Model

A link in the topology model connects the termination point on the source node to the termination point on the destination node. When such a link is instantiated, the bindings between the nodes and the corresponding Adj-SIDs are formed, and the resulting FIB entries are installed.

3. Model Structure

The model tree structure of the Segment Routing (SR) topology module is as shown below:

```
   module: ietf-sr-topology
     augment /nw:networks/nw:network/nw:network-types
               /l3t:l3-unicast-topology:
       +--rw sr!
     augment /nw:networks/nw:network/l3t:l3-topology-attributes:
       +--rw sr
          +--rw srgb* [lower-bound upper-bound]
             +--rw lower-bound    uint32
             +--rw upper-bound    uint32
     augment /nw:networks/nw:network/nw:node/l3t:l3-node-attributes:
       +--rw sr
          +--rw srgb* [lower-bound upper-bound]
          |  +--rw lower-bound    uint32
          |  +--rw upper-bound    uint32
          +--rw srlb* [lower-bound upper-bound]
          |  +--rw lower-bound    uint32
          |  +--rw upper-bound    uint32
          +--rw node-capabilities
          |  +--rw transport-planes* [transport-plane]
          |  |  +--rw transport-plane    identityref
          |  +--rw readable-label-stack-depth?   uint8
          +--ro information-source?         enumeration
          +--ro information-source-state
             +--ro credibility-preference?   uint16
     augment /nw:networks/nw:network/nw:node/l3t:l3-node-attributes
               /l3t:prefix:
       +--rw sr!
          +--rw value-type?          enumeration
          +--rw start-sid            uint32
          +--rw range?               uint32
          +--rw algorithm?           identityref
          +--rw last-hop-behavior?   enumeration
          |       {sid-last-hop-behavior}?
          +--rw is-local?            boolean
     augment /nw:networks/nw:network/nw:node/nt:termination-point
               /l3t:l3-termination-point-attributes:
       +--rw sr!
          +--rw value-type?                enumeration
          +--rw sid                        uint32
          +--rw advertise-protection?      enumeration
          +--rw is-local?                  boolean
          +--ro is-backup?                 boolean
          +--ro is-part-of-set?            boolean
          +--ro is-on-lan?                 boolean
          +--ro information-source?        enumeration
          +--ro information-source-state
             +--ro credibility-preference?   uint16
```

4. YANG Module

```
<CODE BEGINS> file "ietf-sr-topology@2018-06-22.yang"
module ietf-sr-topology {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-sr-topology";
  prefix "srt";

  import ietf-network {
    prefix "nw";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-network-topology {
    prefix "nt";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-l3-unicast-topology {
    prefix "l3t";
    reference "RFC 8346: A YANG Data Model for Layer 3 Topologies";
  }
  import ietf-segment-routing-common {
    prefix "sr-cmn";
    reference
      "I-D.ietf-spring-sr-yang: YANG Data Model for Segment Routing";
  }

  organization
    "IETF Traffic Engineering Architecture and Signaling (TEAS)
     Working Group";

  contact
    "WG Web:   <http://tools.ietf.org/wg/teas/>
     WG List:  <mailto:teas@ietf.org>

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               <mailto:xufeng.liu.ietf@gmail.com>

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     Editor:   Himanshu Shah
```

```
                <mailto:hshah@ciena.com>

    Editor:     Stephane Litkowski
                <mailto:stephane.litkowski@orange.com>";

  description
    "YANG data model for representing and manipulating Segment
     Routing Topologies.

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     authors of the code.  All rights reserved.

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     Relating to IETF Documents
     (http://trustee.ietf.org/license-info).

     This version of this YANG module is part of RFC XXXX; see the
     RFC itself for full legal notices.";

  revision 2018-06-22 {
    description "Initial revision";
    reference
      "RFC XXXX: YANG Data Model for SR and SR TE Topologies";
  }

  grouping sr-topology-type {
    description
      "Identifies the SR topology type.";
    container sr {
      presence "Indiates SR Topology";
      description
        "Its presence identifies the SR topology type.";
    }
  }

  augment "/nw:networks/nw:network/nw:network-types/"
    + "l3t:l3-unicast-topology" {
    description
      "Defines the SR topology type.";
    uses sr-topology-type;
  }

  augment "/nw:networks/nw:network/l3t:l3-topology-attributes" {
    when "../nw:network-types/l3t:l3-unicast-topology/srt:sr" {
      description "Augment only for SR topology.";
```

```
      }
      description "Augment topology configuration";
      uses sr-topology-attributes;
    }

    augment "/nw:networks/nw:network/nw:node/l3t:l3-node-attributes" {
      when "../../nw:network-types/l3t:l3-unicast-topology/srt:sr" {
        description "Augment only for SR topology.";
      }
      description "Augment node configuration.";
      uses sr-node-attributes;
    }

    augment "/nw:networks/nw:network/nw:node/l3t:l3-node-attributes"
      + "/l3t:prefix" {
      when "../../../nw:network-types/l3t:l3-unicast-topology/srt:sr" {
        description "Augment only for SR topology.";
      }
      description "Augment node prefix.";
      uses sr-node-prefix-attributes;
    }

    augment "/nw:networks/nw:network/nw:node/nt:termination-point/"
      + "l3t:l3-termination-point-attributes" {
      when "../../../nw:network-types/l3t:l3-unicast-topology/"
        + "srt:sr" {
        description "Augment only for SR topology.";
      }
      description "Augment termination point configuration";
      uses sr-tp-attributes;
    }

    grouping sr-topology-attributes {
      description "SR topology scope attributes.";
      container sr {
        description
          "Containing SR attributes.";
        uses sr-cmn:srgb-cfg;
      } // sr
    } // sr-topology-attributes

    grouping information-source-attributes {
      description
        "The attributes identifying source that has provided the
         related information, and the source credibility.";
      leaf information-source {
        type enumeration {
          enum "unknown" {
```

```
            description "The source is unknown.";
          }
          enum "locally-configured" {
            description "Configured entity.";
          }
          enum "ospfv2" {
            description "OSPFv2.";
          }
          enum "ospfv3" {
            description "OSPFv3.";
          }
          enum "isis" {
            description "ISIS.";
          }
          enum "system-processed" {
            description "System processed entity.";
          }
          enum "other" {
            description "Other source.";
          }
        }
        config false;
        description
          "Indicates the source of the information.";
      }
      container information-source-state {
        config false;
        description
          "The container contains state attributes related to
           the information source.";
        leaf credibility-preference {
          type uint16;
          description
            "The preference value to calculate the traffic
             engineering database credibility value used for
             tie-break selection between different
             information-source values.
             Higher value is more preferable.";
        }
      }
    } // information-source-attributes

    grouping sr-node-attributes {
      description "SR node scope attributes.";
      container sr {
        description
          "Containing SR attributes.";
        uses sr-cmn:srgb-cfg;
```

```
        uses sr-cmn:srlb-cfg;
        uses sr-cmn:node-capabilities;
        // Operational state data
        uses information-source-attributes;
      } // sr
    } // sr-node-attributes

    grouping sr-node-prefix-attributes {
      description "Containing SR attributes for a prefix.";
      container sr {
        presence "Presence indicates SR is enabled.";
        description
          "Containing SR attributes for a prefix.";
        uses sr-cmn:prefix-sid-attributes;
        uses sr-cmn:last-hop-behavior;
        leaf is-local {
          type boolean;
          description
            "'true' if the SID is local.";
        }
      } // sr
    } // sr-node-prefix-attributes

    grouping sr-tp-attributes {
      description "SR termination point scope attributes";
      container sr {
        presence "Presence indicates SR is enabled.";
        description
          "Containing SR attributes.";
        uses sr-cmn:sid-value-type;
        leaf sid {
          type uint32;
          mandatory true;
          description
            "Adjacency SID, which can be either IGP-Adjacency SID
             or BGP PeerAdj SID, depending on the context.";
        }
        leaf advertise-protection {
          type enumeration {
            enum "single" {
              description
                "A single Adj-SID is associated
                 with the adjacency and reflects
                 the protection configuration.";
            }
            enum "dual" {
              description
                "Two Adj-SIDs will be associated
```

```
                with the adjacency if interface
                is protected. In this case
                one will be enforced with
                backup flag set, the other
                will be enforced to backup flag unset.
                In case, protection is not configured,
                a single Adj-SID will be advertised
                with backup flag unset.";
            }
          }
          description
            "If set, the Adj-SID refers to an
             adjacency being protected.";
        }
        leaf is-local {
          type boolean;
          description
            "'true' if the SID is local.";
        }
        leaf is-backup {
          type boolean;
          config false;
          description
            "'true' if the SID is a backup.";
        }
        leaf is-part-of-set {
          type boolean;
          config false;
          description
            "'true' if the SID is part of a set.";
        }
        leaf is-on-lan {
          type boolean;
          config false;
          description
            "'true' if on a lan.";
        }
        uses information-source-attributes;
      } // sr
    } // sr-tp-attributes
  }
  <CODE ENDS>
```

5. IANA Considerations

RFC Ed.: In this section, replace all occurrences of 'XXXX' with the actual RFC number (and remove this note).

This document registers the following namespace URIs in the IETF XML registry [RFC3688]:

```
---------------------------------------------------------------------
URI: urn:ietf:params:xml:ns:yang:ietf-sr-topology
Registrant Contact: The IESG.
XML: N/A, the requested URI is an XML namespace.
---------------------------------------------------------------------

---------------------------------------------------------------------
URI: urn:ietf:params:xml:ns:yang:ietf-sr-topology-state
Registrant Contact: The IESG.
XML: N/A, the requested URI is an XML namespace.
---------------------------------------------------------------------
```

This document registers the following YANG modules in the YANG Module Names registry [RFC6020]:

```
---------------------------------------------------------------------
name:         ietf-sr-topology
namespace:    urn:ietf:params:xml:ns:yang:ietf-sr-topology
prefix:       srt
reference:    RFC XXXX
---------------------------------------------------------------------

---------------------------------------------------------------------
name:         ietf-sr-topology-state
namespace:    urn:ietf:params:xml:ns:yang:ietf-sr-topology-state
prefix:       srt-s
reference:    RFC XXXX
---------------------------------------------------------------------
```

6. Security Considerations

The configuration, state, action and notification data defined in this document are designed to be accessed via the NETCONF protocol [RFC6241]. The data-model by itself does not create any security implications. The security considerations for the NETCONF protocol are applicable. The NETCONF protocol used for sending the data supports authentication and encryption.

7. References

7.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011, <https://www.rfc-editor.org/info/rfc6241>.

[RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", RFC 7950, DOI 10.17487/RFC7950, August 2016, <https://www.rfc-editor.org/info/rfc7950>.

[RFC8342] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K., and R. Wilton, "Network Management Datastore Architecture (NMDA)", RFC 8342, DOI 10.17487/RFC8342, March 2018, <https://www.rfc-editor.org/info/rfc8342>.

7.2. Informative References

[RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", BCP 215, RFC 8340, DOI 10.17487/RFC8340, March 2018, <https://www.rfc-editor.org/info/rfc8340>.

[RFC8345] Clemm, A., Medved, J., Varga, R., Bahadur, N., Ananthakrishnan, H., and X. Liu, "A YANG Data Model for Network Topologies", RFC 8345, DOI 10.17487/RFC8345, March 2018, <https://www.rfc-editor.org/info/rfc8345>.

[RFC8346] Clemm, A., Medved, J., Varga, R., Liu, X., Ananthakrishnan, H., and N. Bahadur, "A YANG Data Model for Layer 3 Topologies", RFC 8346, DOI 10.17487/RFC8346, March 2018, <https://www.rfc-editor.org/info/rfc8346>.

[I-D.ietf-teas-yang-te-topo] Liu, X., Bryskin, I., Beeram, V., Saad, T., Shah, H., and O. Dios, "YANG Data Model for Traffic Engineering (TE) Topologies", draft-ietf-teas-yang-te-topo-18 (work in progress), June 2018.

[I-D.ietf-spring-sr-yang]
Litkowski, S., Qu, Y., Sarkar, P., and J. Tantsura, "YANG Data Model for Segment Routing", draft-ietf-spring-sr-yang-08 (work in progress), December 2017.

Appendix A. Companion YANG Model for Non-NMDA Compliant Implementations

The YANG module ietf-sr-topology defined in this document is designed to be used in conjunction with implementations that support the Network Management Datastore Architecture (NMDA) defined in [RFC8342]. In order to allow implementations to use the model even in cases when NMDA is not supported, the following companion module, ietf-sr-topology-state, is defined as state model, which mirrors the module ietf-sr-topology defined earlier in this document. However, all data nodes in the companion module are non-configurable, to represent the applied configuration or the derived operational states.

The companion module, ietf-sr-topology-state, is redundant and SHOULD NOT be supported by implementations that support NMDA.

As the structure of the companion module mirrors that of the coorespinding NMDA model, the YANG tree of the companion module is not depicted separately.

A.1. SR Topology State Module

```
<CODE BEGINS> file "ietf-sr-topology-state@2018-06-22.yang"
module ietf-sr-topology-state {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-sr-topology-state";
  prefix "srt-s";

  import ietf-sr-topology {
    prefix "srt";
  }
  import ietf-network-state {
    prefix "nw-s";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-network-topology-state {
    prefix "nt-s";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-l3-unicast-topology-state {
    prefix "l3t-s";
    reference "RFC 8346: A YANG Data Model for Layer 3 Topologies";
  }
  import ietf-segment-routing-common {
    prefix "sr-cmn";
    reference
      "I-D.ietf-spring-sr-yang: YANG Data Model for Segment Routing";
```

```
    }

    organization
      "IETF Traffic Engineering Architecture and Signaling (TEAS)
       Working Group";

    contact
      "WG Web:   <http://tools.ietf.org/wg/teas/>
       WG List:  <mailto:teas@ietf.org>

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       Editor:   Himanshu Shah
                 <mailto:hshah@ciena.com>

       Editor:   Stephane Litkowski
                 <mailto:stephane.litkowski@orange.com>";

    description
      "YANG data model for representing operational state information
       of Segment Routing Topologies, when NMDA is not supported.

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       Relating to IETF Documents
       (http://trustee.ietf.org/license-info).

       This version of this YANG module is part of RFC XXXX; see the
       RFC itself for full legal notices.";

    revision 2018-06-22 {
      description "Initial revision";
      reference
```

```
        "RFC XXXX: YANG Data Model for SR and SR TE Topologies";
    }

    augment "/nw-s:networks/nw-s:network/nw-s:network-types/"
      + "l3t-s:l3-unicast-topology" {
      description
        "Defines the SR topology type.";
      uses srt:sr-topology-type;
    }

    augment "/nw-s:networks/nw-s:network/"
      + "l3t-s:l3-topology-attributes" {
      when "../nw-s:network-types/l3t-s:l3-unicast-topology/srt-s:sr" {
        description "Augment only for SR topology.";
      }
      description "Augment topology configuration";
      uses srt:sr-topology-attributes;
    }

    augment "/nw-s:networks/nw-s:network/nw-s:node/"
      + "l3t-s:l3-node-attributes" {
      when "../../nw-s:network-types/l3t-s:l3-unicast-topology/"
        + "srt-s:sr" {
        description "Augment only for SR topology.";
      }
      description "Augment node configuration.";
      uses srt:sr-node-attributes;
    }

    augment "/nw-s:networks/nw-s:network/nw-s:node/"
      + "l3t-s:l3-node-attributes/l3t-s:prefix" {
      when "../../../nw-s:network-types/l3t-s:l3-unicast-topology/"
        + "srt-s:sr" {
        description "Augment only for SR topology.";
      }
      description "Augment node prefix.";
      uses srt:sr-node-prefix-attributes;
    }

    augment "/nw-s:networks/nw-s:network/nw-s:node/"
      + "nt-s:termination-point/"
      + "l3t-s:l3-termination-point-attributes" {
      when "../../../nw-s:network-types/l3t-s:l3-unicast-topology/"
        + "srt-s:sr" {
        description "Augment only for SR topology.";
      }
      description "Augment termination point configuration";
      uses srt:sr-tp-attributes;
```

```
    }

    grouping sr-topology-attributes {
      description "SR topology scope attributes.";
      container sr {
        description
          "Containing SR attributes.";
        uses sr-cmn:srgb-cfg;
      } // sr
    } // sr-topology-attributes
  }
  <CODE ENDS>
```

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